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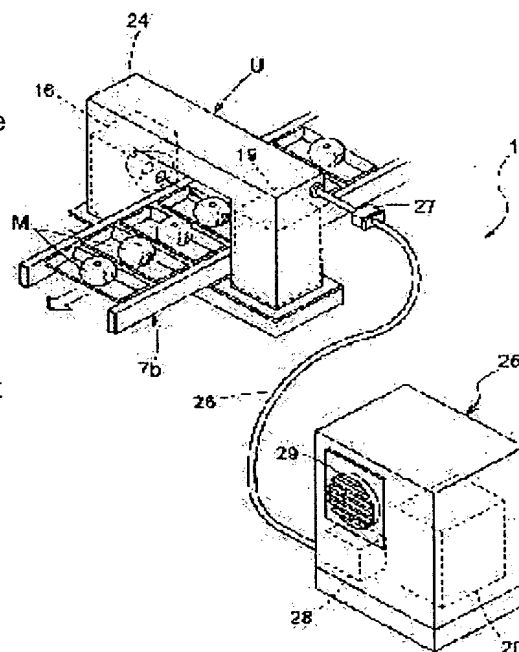
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## (54) MEASURING DEVICE FOR INTERNAL QUALITY OF AGRICULTURAL PRODUCT

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a measuring device for internal quality of agricultural products capable of appropriately measuring the internal quality of agricultural products over a long period through the easiness of maintenance work.

**SOLUTION:** This measuring device for internal quality of agricultural products is provided with a light projecting part 16 provided with a light source 15 for projecting light to a measuring object; a light receiving part 19 provided with a concave diffraction grating 17 receiving light transmitted through the measured object and making spectral diffraction, and an array type light receiving element 18 for measuring the light subjected to spectral diffraction; and an arithmetic processing part 20 for obtaining the internal quality information of the measuring object on the basis of the measured result of the array type light receiving element 18. In the device, the light projecting part 16 and the light receiving part 19 are arranged being distributed on both lateral sides of the measuring objects and constituted as an integrally unitized optical unit U, and the optical unit U is detachably provided in a separable state from the arithmetic processing part 20.



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CLAIMS

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[Claim(s)]

[Claim 1] the spectrum which receives and carries out the spectrum of the floodlighting section equipped with a floodlighting means to project light, and the light which penetrated said measured object to a measured object -- a means and the spectrum which measures the light which carried out the spectrum -- with the light sensing portion equipped with each measurement means As opposed to said measured object which is equipped with the data-processing section which asks for the internal quality information of a measured object, is constituted based on the measurement result of a measurement means, and is located in the part for measurement said spectrum -- In the condition that light is received in said light sensing portion after the light projected from said floodlighting section penetrates said measured object It is the internal quality metering device of the agricultural products constituted so that said floodlighting section and said light sensing portion may distribute to the right-and-left both-sides part of said measured object and may be arranged. The internal quality metering device of the agricultural products with which it is constituted as an optical unit to which unitization of said floodlighting section and said light sensing portion was carried out in one, and this optical unit is prepared removable in the condition freely separable from said data-processing section.

[Claim 2] The internal quality metering device of the agricultural products according to claim 1 which said measured object is conveyed in the state of a column by conveyance conveyor, and are constituted one by one so that it may pass through said part for measurement.

[Claim 3] said optical unit -- respectively -- each \*\* -- a spectrum -- the internal quality metering device of the agricultural products according to claim 1 or 2 with which it has two or more sets, and said data-processing section consists of measurable conditions so that it may ask for the internal quality information of two or more measured objects which the measurement result of said optical unit of these two or more groups is inputted, respectively, and are measured in each optical unit, respectively.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the equipment for measuring the internal quality of the agricultural products of the fruit of for example, a mandarin orange and others, vegetables, etc. in detail the spectrum which receives and carries out the spectrum of the floodlighting section equipped with a floodlighting means to project light, and the light which penetrated said measured object to a measured object -- a means and the spectrum which measures the light which carried out the spectrum -- with the light sensing portion equipped with each measurement means As opposed to said measured object which is equipped with the data-processing section which asks for the internal quality information of a measured object, is constituted based on the measurement result of a measurement means, and is located in the part for measurement said spectrum -- After the light projected from said floodlighting section penetrates said measured object, it is related with the internal quality metering device of the agricultural products constituted so that said floodlighting section and said light sensing portion may distribute to the right-and-left both-sides part of said measured object and may be arranged in the condition that light is received in said light sensing portion.

[0002]

[Description of the Prior Art] The internal quality metering device of the agricultural products of the above-mentioned configuration is used in the sorting facility for carrying out sorting classification of the agricultural products etc., and light is projected on a measured object with the floodlighting means which consists of a halogen lamp etc. It is made to measure with a measurement means. the spectrum which consists of a concave grating etc. the light which penetrated the measured object -- the spectrum which consists of a CCD line sensor etc. the light which carried out the spectrum after carrying out a spectrum with a means -- It asks for internal quality information, for example, the sugar content, acidity, etc. of agricultural products based on the measurement result. Since the spectral characteristics of the absorbance of the component corresponding to a sugar content, acidity, etc. differ mutually, this calculates the amount of components based on the measurement result of a spectrum.

[0003] In the internal quality metering device of this kind of agricultural products and in the former For example, carrying out installation conveyance of the measured object M one by one in the state of a column by conveyance conveyor 40, as shown in drawing 7 While the right-and-left both-sides part of the conveyance path of this conveyance conveyor 40 is equipped with the floodlighting section 16 and a light sensing portion 19 in the condition of being distributed and arranged There were some by which the whole equipment which also includes said data-processing section 20 in addition to those floodlighting sections 16 and light sensing portions 19 was unified and constituted from a condition of being contained in the large-sized casing 41.

[0004]

[Problem(s) to be Solved by the Invention] However, since the whole equipment is unified and constituted in a configuration conventionally [ above-mentioned ], there were the following disadvantageous fields and there was room of an improvement. That is, in an initial installation

condition, while being projected on the light for measurement in the suitable condition to the measured object located in the part for measurement, an internal quality metering device which was described above will be installed in the state of location immobilization so that it may become the suitable posture which the transmitted light can receive exactly in a light sensing portion. And when it follows on performing measurement processing of the internal quality of agricultural products using such an internal quality metering device, for example, the floodlighting engine performance of a floodlighting means falls, it is necessary to exchange this to a new thing. Since it is installed at this time where the whole equipment is unified in a configuration conventionally [ above-mentioned ], only a floodlighting means will be removed and it will exchange for another new floodlighting means.

[0005] And when exchanging a floodlighting means in this way, while being projected on the light for measurement in the suitable condition to the measured object located in the part for measurement the activity by which the optical axis of the floodlighting section and a light sensing portion is set so that the transmitted light can receive light exactly in a light sensing portion, and the condition using a new floodlighting means by which it was exchanged -- a spectrum -- while the activity which adjusts the measurement sensibility by the measurement means adjusts an optical property, it is necessary to install a floodlighting means in the state of location immobilization. However, since the whole equipment was unified and it was installed near the part for measurement as mentioned above, there was disadvantage used as what a maintenance called the tuning of an optical property cannot perform in the exchange list of such a floodlighting means easily. Moreover, since it was hard to perform such tuning, after being exchanged in the floodlighting means, a possibility that it might become impossible to measure internal quality of agricultural products proper, without installing a floodlighting means proper was also.

[0006] This invention is made paying attention to this point, and the purpose is made to what is easy to perform a maintenance of optical tuning etc., and is in the point of offering the internal quality metering device of the agricultural products which become possible [ measuring internal quality of agricultural products proper over a long period of time ].

[0007]

[Means for Solving the Problem] The floodlighting section which was equipped with a floodlighting means to project light on a measured object according to claim 1, the spectrum which receives and carries out the spectrum of the light which penetrated said measured object -- a means and the spectrum which measures the light which carried out the spectrum -- with the light sensing portion equipped with each measurement means. As opposed to said measured object which is equipped with the data-processing section which asks for the internal quality information of a measured object, is constituted based on the measurement result of a measurement means, and is located in the part for measurement said spectrum -- In the condition that light is received in said light sensing portion after the light projected from said floodlighting section penetrates said measured object. In the internal quality metering device of the agricultural products constituted so that said floodlighting section and said light sensing portion may distribute to the right-and-left both-sides part of said measured object and may be arranged. Said floodlighting section and said light sensing portion are constituted as an optical unit by which unitization was carried out in one, and are characterized by preparing this optical unit removable in the condition freely separable from said data-processing section.

[0008] For example, when exchanging component parts, such as a floodlighting means, for a new thing, the optical unit by which unitization is carried out in one can be made to be able to separate from the data-processing section, it can remove, and a maintenance can be performed in different somewhere else from the location in which this internal quality metering device is installed in exchange of a component part, the tuning of an optical property, etc. Namely, since unitization of the floodlighting section and the light sensing portion is carried out in one, said optical unit. Make the optical unit separate from the data-processing section, remove, and it moves to somewhere else where it had an adjustment implement, a measuring device, etc. of dedication for tuning. While being projected on the light for measurement in the suitable condition to the measured object located in the part for measurement after exchanging component parts, such as a floodlighting means, for example the activity by which the optical axis of the floodlighting section and a light sensing portion is set so that the transmitted light can receive light

exactly in a light sensing portion, and the condition using the exchanged new component part -- a spectrum -- by performing tuning of optical properties, such as an activity which adjusts the measurement sensibility by the measurement means Using an adjustment implement, a measuring device, etc. of dedication, it can work easily and, moreover, it also becomes possible to perform optical tuning with a sufficient precision. It compares, when the whole equipment is installed in the state of location immobilization by the installation in the condition of it having been contained and having been unified in casing, like a configuration before. therefore, the above -- It is made to what is easy to perform a maintenance of exchange of a component part, optical tuning which was mentioned above, and was able to come to offer the internal quality metering device of the agricultural products which moreover become it is possible to perform tuning with a sufficient precision, and possible [ measuring internal quality of agricultural products proper over a long period of time ].

[0009] According to claim 2, in claim 1, said measured object is characterized by being conveyed in the state of a column by conveyance conveyor, and being constituted one by one, so that it may pass through said part for measurement.

[0010] That is, a measured object will be conveyed in the state of a column by conveyance conveyor, and it will pass through the part for measurement one by one. And when each \*\*\*\*\* is located in the part for measurement, the internal quality information of a measured object is measured. thus, in being a configuration conventionally from which the whole equipment is unified and equipment becomes large-sized in the configuration which the floodlighting section and a light sensing portion distribute to the right-and-left both-sides part of a conveyance conveyor, and by which they are arranged Although there is disadvantage used as what such an activity cannot perform easily to the measured object conveyed by conveyance conveyor when working optical-axis doubling of the floodlighting section or a light sensing portion etc. Since it dissociates from the data-processing section and an optical unit will become lightweight and compact by the invention in this application compared with this, it is so easy to perform optical tuning, such as optical-axis doubling of the floodlighting section or a light sensing portion.

[0011] according to claim 3 -- claim 1 or 2 -- setting -- said optical unit -- respectively -- each \*\* -- a spectrum -- it is characterized by having two or more sets , and said data processing section consisting of measurable conditions so that it may ask for the internal quality information of two or more measured objects with which the measurement result of said optical unit of these two or more groups is inputted , respectively , and is measured in each optical unit , respectively .

[0012] That is, low cost-ization was attained at the simplification list of the configuration of the whole equipment by common-use-izing the data-processing section to two or more optical units as a configuration which asks for the internal quality information of two or more measured objects measured in two or more optical units, using effectively the point that an optical unit is prepared free [ separation ] to the data-processing section, in the data-processing section, respectively.

[0013]

[Embodiment of the Invention] Hereafter, the internal quality metering device of the agricultural products concerning this invention is explained based on a drawing about the case where it applies to the fruit-sorting facility for carrying out sorting processing, conveying a mandarin orange M as an example of agricultural products.

[0014] The mandarin orange M as an example of agricultural products is carried in after having been contained by Container C, respectively, and said fruit-sorting facility emits Container C to the mandarin orange M from the middle of the conveyance path, and is made to carry out installation conveyance. While it picturizes each one mandarin orange M at a time and an image processing performs appearance distinction of a blemish etc. from the magnitude, information on a color, etc. an example of internal quality -- the sugar content and acidity of the \*\* mandarin orange M -- measuring -- those information -- each mandarin orange M -- as two or more quality ranks -- etc. -- sorting processing of \*\*\*\*\*, for example, box setting weight every, is given to class.

[0015] Hereafter, the configuration of the outline of this processing facility is explained. As shown in drawing 1 , in the acceptance section 1, after it was loaded by the conveyance car etc. and having been contained by Container C, a mandarin orange M is carried in, and reception processing is performed.

After having been contained by Container C by the automatic transferring machine 2 in the condition of locating two or more containers C in the shape of [ which meets in the conveyance direction ] a column, sequential installation is carried out at the 1st transport device 3, and sequential conveyance of the mandarin orange M carried in to the acceptance section 1 is carried out towards a back process. In the measuring processing section 5, as for the container C which sequential installation is carried out and is conveyed by the 1st transport device 3, weight is measured at a time by one metering installation 6. In this processing facility, since it processes putting in order and conveying the agricultural-products group (mandarin orange M) for every consignment in the conveyance direction as it is necessary to process efficiently a lot of mandarin oranges M of many numbers of consignment and they were mentioned above, when the mandarin orange M of many numbers of consignment is carried in between short time, it will stand by using the standby location T. In the part where Container C is conveyed from the standby location T On the installation conveyance side of double-width transport-device 7a prepared along the conveyance direction of Container C, and the crossing direction The damper gear 4 to which the mandarin orange M contained by Container C is made to emit is formed, and after being emitted in the condition that the mandarin orange M in Container C stacks with this damper gear 4, and there is no lap, installation conveyance of the mandarin orange M is carried out in double-width transport-device 7a. At this time, the empty containers C are collected separately.

[0016] As shown in drawing 2 , the mandarin orange M by which installation conveyance is carried out in transport-device 7a After passing the washing processing section 8 which performs washing processing, wax treating, the desiccation processing accompanying it, etc., It switches to the condition that installation conveyance is carried out in the condition of being in the condition that the mandarin orange M by which installation conveyance was carried out in the scattering condition is located [ till then ] in a line in the shape of a column along the conveyance direction at a single tier with the CHANE riser 9 in a double-width conveyance path, and having branched to conveyance conveyor 7b of two or more trains (six trains). And the mandarin orange M conveyed in the state of a column in conveyance Rhine of such six trains, respectively the image measurement section 10 which picturizes at a time with one image pick-up means, such as a CCD camera, and distinguishes appearance information, such as a blemish, from the magnitude, information on a color, etc. by the image processing -- so that it may mention later Based on the internal quality measurement sections 11 which measure one internal quality, such as a sugar content of a mandarin orange M, and acidity, at a time by spectral analysis, and those measurement results, it judges to any of the classes, such as plurality, each mandarin orange M is corresponded. The classification processing section 13 grade equipped with the distribution equipment 12 grade distributed and supplied to conveyance Rhine separately prepared for every class, such as corresponding, is prepared. moreover -- such -- etc. -- the automatic packing section 14 which carries out setting weight [ every ] automatic packing of the classification \*\*\*\*\* mandarin orange M according to each \*\*\*\*\* based on the result of a class judging is formed. In addition, actuation of each part has composition controlled by the management equipment H which generalizes and manages the whole system.

[0017] Next, the configuration of the internal quality measurement section 11 is explained. In each of conveyance Rhine of six trains, this internal quality measurement section 11 is conveyed by each conveyance conveyor 7b in the state of a column, and it is constituted so that that internal quality may be measured one by one by making applicable to measurement each mandarin orange M which passes through the part for measurement. And the floodlighting section 16 equipped with the light source 15 as a floodlighting means to project light on a measured object (mandarin orange M) as shown in drawing 3 and drawing 4 , the spectrum which receives and carries out the spectrum of the light which penetrated the measured object -- the concave grating 17 as a means, and the spectrum which measures the light which carried out the spectrum -- with the light sensing portion 19 equipped with the array mold photo detector 18 grade as a measurement means As opposed to the measured object which is equipped with the data-processing section 20 grade which asks for the internal quality information of a measured object, is constituted based on the measurement result of the array mold photo detector 18, and is further located in the part for measurement After the light projected from the floodlighting section 16 penetrates

a measured object, it is constituted so that the floodlighting section 16 and a light sensing portion 19 may distribute to the right-and-left both-sides part of a measured object and may be arranged in the condition that light is received by the light sensing portion 19. In addition, said light source 15 consists of tungsten halogen lamps.

[0018] Said light sensing portion 19 a concave grating 17 and the array mold photo detector 18 It has composition arranged in the black box 21 which consists of a protection-from-light nature ingredient which shades the light from the outside. After the transmitted light which carried out incidence from ON \*\*\*\* 22 after the light projected from the floodlighting section 16 penetrated the measured object is reflected with a reflecting mirror 23, the optical reinforcement for every wavelength in which the part light reflex was carried out by the concave grating 17 and by which the light reflex was carried out at this rate has composition measured by the array mold photo detector 18. Said array mold photo detector 18 changes and outputs the transmitted light by which the part light reflex was carried out by the concave grating 17 to the signal for every wavelength while receiving light for every wavelength to coincidence. Moreover, the array mold photo detector 18 consists of 1024-bit single dimension CCD line sensors, and can detect now the light of the wavelength of the range whose wavelength is 700nm - 1000nm.

[0019] Said data-processing section 20 is constituted using the microcomputer, and it is constituted so that the amount of components corresponding to the sugar content contained in a measured object by the quadratic differential value and the amount of components corresponding to acidity may be computed, while processing the output signal from the array mold photo detector 18 and acquiring the quadratic differential value in the wavelength field of an absorbance spectrum and an absorbance spectrum. An absorbance is  $\text{Log}(I/T)$  when the quantity of light of I and the transmitted light is set to T for the exposure quantity of light (criteria quantity of light) of the light source 15.

Coming out and defining, the data-processing section 20 computes the amount of components contained in a measured object based on the multiple regression analysis by the following formula 1.

[0020]

[Equation 1]

$Y = K_0 + K_1 \cdot A(\lambda_1) + K_2 \cdot A(\lambda_2)$

[0021] However, Y ; The amounts  $K_0$ ,  $K_1$ , and  $K_2$  of components ; A coefficient A ( $\lambda_1$ ), A ( $\lambda_2$ ) ; quadratic differential value of the absorbance spectrum in the specific wavelength  $\lambda_1$

[0022] In addition, for every component which computes the amount of components, the specific amount formula of components, the specific multipliers  $K_0$ ,  $K_1$ , and  $K_2$  and wavelength  $\lambda_1$ , and  $\lambda_2$  grade are beforehand set up by the data-processing section 20, are memorized, and have at it composition which computes the amount of components of each component using the specific amount formula of components for every component of this.

[0023] And it is constituted as an optical unit U to which unitization of the floodlighting section 16 and the light sensing portion 19 was carried out in one. this optical unit U prepares removable in the condition freely separable from the data-processing section 20 -- having -- \*\*\*\* -- moreover -- the optical unit U -- respectively -- each \*\* -- a spectrum -- in the measurable condition It has two or more sets, and the measurement result of the optical unit U of these two or more groups is inputted, respectively, and the data-processing section 20 is constituted so that it may ask for the internal quality information of two or more measured objects measured in each optical unit U, respectively. As shown in drawing 3, that is, the optical unit U It is prepared in the condition of being contained in the casing 24 for optics in which the floodlighting section 16 and a light sensing portion 19 were formed in one. This casing 24 for optics In the body casing 25 by which the data-processing section 20 is contained, it consists of another objects, and the signal line 26 for signal transduction is also constituted by the connection list free [ separation ] through the connector 27, and the optical unit U is formed removable in the condition freely separable from the data-processing section 20. Said body casing 25 is equipped with the power unit 28 which supplies the power source over the data-processing section 20, and the cooling-fan 29 grade cooled so that the interior of casing may not become an elevated temperature, since there is a possibility that operation precision may fall if a temperature change is large.



[0024] And as shown in drawing 2, in each of conveyance Rhine of six trains, it has one piece at a time, said data-processing section 20 has composition prepared two sets, and said optical unit U has the composition that each signal from two or more three optical units U of every is processed in the one data-processing section 20. Namely, while the signal output timing in three optical units U shifts timing with time-division system Although it has the composition of being inputted into the data-processing section 20, respectively and a detailed explanation is not carried out, in the data-processing section 20 The internal quality (a sugar content, acidity, etc.) of the measured section measured in each optical unit U is searched for by carrying out data processing of the timing based on the measurement information from each optical unit U shifted and inputted, where time sharing is carried out. And the measurement result will be sent to management equipment H, and will be used as information for classification.

[0025] Thus, when change has arisen in the property by the case so that the light source 15 may be exchanged to a new thing by being constituted, or long-term use, it sets. When the wavelength-calibration processing which decides what the wavelength of the light which carries out ON light has become is needed for each component of the array mold photo detector 18, tuning can be performed in somewhere else which separates and removes the optical unit U and is different from the installation part of equipment. In addition, when removing one of things among six optical units U, in other conveyance Rhine, measurement processing can be continued by stopping conveyance of the mandarin orange M in conveyance Rhine which corresponds with said CHANE riser 9.

[0026] If explanation is added about the above-mentioned wavelength-calibration processing, as shown in drawing 5, the light guide section material 30 which leads the light for measurement projected from the light source 15 where an external light is covered to ON \*\*\*\* 22 of a light sensing portion 19 will be prepared separately. The section is equipped with the filter 31 for proofreading which is made to penetrate the light for measurement and is made into the light for proofreading in the middle of this light guide section material 30. The light for proofreading after passing this filter 31 for proofreading As shown in drawing 6, it is the bundle of rays which equipped specific fixed wavelength ( $\lambda S1$ ,  $\lambda S2$ ) with the peak. From the physical relationship of the photo detector of the pair of the array mold photo detector 18 which will receive the peak wavelength and such peak wavelength of the pair specified beforehand, correspondence can be taken between each component which constitutes the array mold photo detector 18, and the wavelength of the light which each component receives.

[0027] By the way, when correspondence relation which was described above must always be adjusted to an initialization condition and the same condition, for example, the light source 15 is exchanged, after that new light source 15 is attached, this correspondence relation must be adjusted. That is, as shown in drawing 5, the optical unit U is equipped with said light guide section material 30. Signal processing is carried out with the signal processor 32 of the dedication which carried out the spectrum of the light for proofreading after passing the filter 31 for proofreading, and measured by the array mold photo detector 18, and prepared the measurement result separately. The sense of a concave grating 17 will be tuned finely, or the location of the array mold photo detector 18 will be finely tuned so that it may double with the thing which is having the photo detector corresponding to specific wavelength ( $\lambda S1$ ,  $\lambda S2$ ) initialized based on the processing result. In addition, it may be made to perform measurement processing of the dark current measured where the exposure quantity of light (criteria quantity of light) and incident light of the light source 15 which were described above are intercepted suitably. Although it is hard to perform such a maintenance in the installation part of equipment, it can carry out easily by separating the optical unit U and carrying out in another part.

[0028] [Another operation gestalt] Another operation gestalt is listed hereafter.

[0029] (1) Although the casing 24 for optics by which the optical unit U is constituted from an above-mentioned operation gestalt, and the body casing 25 by which the data-processing section 20 is contained illustrated that to which it consists of another objects and they are connected only with a signal line, it is good also as a configuration which can connect for example, not only a configuration such but casing for optics, and body casing in one in the disengageable condition.

[0030] (2) Although what consists of above-mentioned operation gestalten so that it may ask for the internal quality information of two or more measured objects which the measurement result of every 3

sets of optical units U is inputted into said data-processing section 20, respectively, and are measured in each optical unit U, respectively was illustrated. It may be good also as a configuration which prepares 2 sets or forms for example, not only a configuration such but 4 or more sets of optical units U to the one data-processing section 20, or the configuration of forming one optical unit U to the one data-processing section 20 may be used.

[0031] (3) Although said measured object was conveyed in the state of the column by conveyance conveyor and what is constituted so that it may pass through said part for measurement one by one was illustrated with the above-mentioned operation gestalt, it is good also as a configuration which supplies every one-piece measured object to the part for measurement for example, such by not only configuration but by the handling robot, or supplies a measured object to the part for measurement by handicraft.

[0032] (4) although what measures a mandarin orange M as said measured object was illustrated with the above-mentioned operation gestalt -- not only the mandarin orange M but an apple -- making -- etc. - other fruit is sufficient and vegetables, such as not only fruit but an eggplant and a tomato, etc. are sufficient.

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TECHNICAL FIELD

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[Field of the Invention] This invention relates to the equipment for measuring the internal quality of the agricultural products of the fruit of for example, a mandarin orange and others, vegetables, etc. in detail the spectrum which receives and carries out the spectrum of the floodlighting section equipped with a floodlighting means to project light, and the light which penetrated said measured object to a measured object -- a means and the spectrum which measures the light which carried out the spectrum -- with the light sensing portion equipped with each measurement means As opposed to said measured object which is equipped with the data-processing section which asks for the internal quality information of a measured object, is constituted based on the measurement result of a measurement means, and is located in the part for measurement said spectrum -- After the light projected from said floodlighting section penetrates said measured object, it is related with the internal quality metering device of the agricultural products constituted so that said floodlighting section and said light sensing portion may distribute to the right-and-left both-sides part of said measured object and may be arranged in the condition that light is received in said light sensing portion.

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PRIOR ART

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[Description of the Prior Art] The internal quality metering device of the agricultural products of the above-mentioned configuration is used in the sorting facility for carrying out sorting classification of the agricultural products etc., and light is projected on a measured object with the floodlighting means which consists of a halogen lamp etc. It is made to measure with a measurement means. the spectrum which consists of a concave grating etc. the light which penetrated the measured object -- the spectrum which consists of a CCD line sensor etc. the light which carried out the spectrum after carrying out a spectrum with a means -- It asks for internal quality information, for example, the sugar content, acidity, etc. of agricultural products based on the measurement result. Since the spectral characteristics of the absorbance of the component corresponding to a sugar content, acidity, etc. differ mutually, this calculates the amount of components based on the measurement result of a spectrum.

[0003] In the internal quality metering device of this kind of agricultural products and in the former For example, carrying out installation conveyance of the measured object M one by one in the state of a column by conveyance conveyor 40, as shown in drawing 7 While the right-and-left both-sides part of the conveyance path of this conveyance conveyor 40 is equipped with the floodlighting section 16 and a light sensing portion 19 in the condition of being distributed and arranged There were some by which the whole equipment which also includes said data-processing section 20 in addition to those floodlighting sections 16 and light sensing portions 19 was unified and constituted from a condition of being contained in the large-sized casing 41.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, since the whole equipment is unified and constituted in a configuration conventionally [ above-mentioned ], there were the following disadvantageous fields and there was room of an improvement. That is, in an initial installation condition, while being projected on the light for measurement in the suitable condition to the measured object located in the part for measurement, an internal quality metering device which was described above will be installed in the state of location immobilization so that it may become the suitable posture which the transmitted light can receive exactly in a light sensing portion. And when it follows on performing measurement processing of the internal quality of agricultural products using such an internal quality metering device, for example, the floodlighting engine performance of a floodlighting means falls, it is necessary to exchange this to a new thing. Since it is installed at this time where the whole equipment is unified in a configuration conventionally [ above-mentioned ], only a floodlighting means will be removed and it will exchange for another new floodlighting means.

[0005] And when exchanging a floodlighting means in this way, while being projected on the light for measurement in the suitable condition to the measured object located in the part for measurement the activity by which the optical axis of the floodlighting section and a light sensing portion is set so that the transmitted light can receive light exactly in a light sensing portion, and the condition using a new floodlighting means by which it was exchanged -- a spectrum -- while the activity which adjusts the measurement sensibility by the measurement means adjusts an optical property, it is necessary to install a floodlighting means in the state of location immobilization. However, since the whole equipment was unified and it was installed near the part for measurement as mentioned above, there was disadvantage used as what a maintenance called the tuning of an optical property cannot perform in the exchange list of such a floodlighting means easily. Moreover, since it was hard to perform such tuning, after being exchanged in the floodlighting means, a possibility that it might become impossible to measure internal quality of agricultural products proper, without installing a floodlighting means proper was also.

[0006] This invention is made paying attention to this point, and the purpose is made to what is easy to perform a maintenance of optical tuning etc., and is in the point of offering the internal quality metering device of the agricultural products which become possible [ measuring internal quality of agricultural products proper over a long period of time ].

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[Translation done.]

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MEANS

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[Means for Solving the Problem] The floodlighting section which was equipped with a floodlighting means to project light on a measured object according to claim 1, the spectrum which receives and carries out the spectrum of the light which penetrated said measured object -- a means and the spectrum which measures the light which carried out the spectrum -- with the light sensing portion equipped with each measurement means As opposed to said measured object which is equipped with the data-processing section which asks for the internal quality information of a measured object, is constituted based on the measurement result of a measurement means, and is located in the part for measurement said spectrum -- In the condition that light is received in said light sensing portion after the light projected from said floodlighting section penetrates said measured object In the internal quality metering device of the agricultural products constituted so that said floodlighting section and said light sensing portion may distribute to the right-and-left both-sides part of said measured object and may be arranged Said floodlighting section and said light sensing portion are constituted as an optical unit by which unitization was carried out in one, and are characterized by preparing this optical unit removable in the condition freely separable from said data-processing section.

[0008] For example, when exchanging component parts, such as a floodlighting means, for a new thing, the optical unit by which unitization is carried out in one can be made to be able to separate from the data-processing section, it can remove, and a maintenance can be performed in different somewhere else from the location in which this internal quality metering device is installed in exchange of a component part, the tuning of an optical property, etc. Namely, since unitization of the floodlighting section and the light sensing portion is carried out in one, said optical unit Make the optical unit separate from the data-processing section, remove, and it moves to somewhere else where it had an adjustment implement, a measuring device, etc. of dedication for tuning. While being projected on the light for measurement in the suitable condition to the measured object located in the part for measurement after exchanging component parts, such as a floodlighting means, for example the activity by which the optical axis of the floodlighting section and a light sensing portion is set so that the transmitted light can receive light exactly in a light sensing portion, and the condition using the exchanged new component part -- a spectrum -- by performing tuning of optical properties, such as an activity which adjusts the measurement sensibility by the measurement means Using an adjustment implement, a measuring device, etc. of dedication, it can work easily and, moreover, it also becomes possible to perform optical tuning with a sufficient precision. It compares, when the whole equipment is installed in the state of location immobilization by the installation in the condition of it having been contained and having been unified in casing, like a configuration before. therefore, the above -- It is made to what is easy to perform a maintenance of exchange of a component part, optical tuning which was mentioned above, and was able to come to offer the internal quality metering device of the agricultural products which moreover become it is possible to perform tuning with a sufficient precision, and possible [ measuring internal quality of agricultural products proper over a long period of time ].

[0009] According to claim 2, in claim 1, said measured object is characterized by being conveyed in the state of a column by conveyance conveyor, and being constituted one by one, so that it may pass

through said part for measurement.

[0010] That is, a measured object will be conveyed in the state of a column by conveyance conveyor, and it will pass through the part for measurement one by one. And when each \*\*\*\*\* is located in the part for measurement, the internal quality information of a measured object is measured. thus, in being a configuration conventionally from which the whole equipment is unified and equipment becomes large-sized in the configuration which the floodlighting section and a light sensing portion distribute to the right-and-left both-sides part of a conveyance conveyor, and by which they are arranged Although there is disadvantage used as what such an activity cannot perform easily to the measured object conveyed by conveyance conveyor when working optical-axis doubling of the floodlighting section or a light sensing portion etc. Since it dissociates from the data-processing section and an optical unit will become lightweight and compact by the invention in this application compared with this, it is so easy to perform optical tuning, such as optical-axis doubling of the floodlighting section or a light sensing portion.

[0011] according to claim 3 -- claim 1 or 2 -- setting -- said optical unit -- respectively -- each \*\* -- a spectrum -- it is characterized by having two or more sets , and said data processing section consisting of measurable conditions so that it may ask for the internal quality information of two or more measured objects with which the measurement result of said optical unit of these two or more groups is inputted , respectively , and is measured in each optical unit , respectively .

[0012] That is, low cost-ization was attained at the simplification list of the configuration of the whole equipment by common-use-izing the data-processing section to two or more optical units as a configuration which asks for the internal quality information of two or more measured objects measured in two or more optical units, using effectively the point that an optical unit is prepared free [ separation ] to the data-processing section, in the data-processing section, respectively.

[0013]

[Embodiment of the Invention] Hereafter, the internal quality metering device of the agricultural products concerning this invention is explained based on a drawing about the case where it applies to the fruit-sorting facility for carrying out sorting processing, conveying a mandarin orange M as an example of agricultural products.

[0014] The mandarin orange M as an example of agricultural products is carried in after having been contained by Container C, respectively, and said fruit-sorting facility emits Container C to the mandarin orange M from the middle of the conveyance path, and is made to carry out installation conveyance. While it picturizes each one mandarin orange M at a time and an image processing performs appearance distinction of a blemish etc. from the magnitude, information on a color, etc. an example of internal quality -- the sugar content and acidity of the \*\* mandarin orange M -- measuring -- those information -- each mandarin orange M -- as two or more quality ranks -- etc. -- sorting processing of \*\*\*\*\*, for example, box setting weight every, is given to class.

[0015] Hereafter, the configuration of the outline of this processing facility is explained. As shown in drawing 1 , in the acceptance section 1, after it was loaded by the conveyance car etc. and having been contained by Container C, a mandarin orange M is carried in, and reception processing is performed. After having been contained by Container C by the automatic transferring machine 2 in the condition of locating two or more containers C in the shape of [ which meets in the conveyance direction ] a column, sequential installation is carried out at the 1st transport device 3, and sequential conveyance of the mandarin orange M carried in to the acceptance section 1 is carried out towards a back process. In the measuring processing section 5, as for the container C which sequential installation is carried out and is conveyed by the 1st transport device 3, weight is measured at a time by one metering installation 6. In this processing facility, since it processes putting in order and conveying the agricultural-products group (mandarin orange M) for every consignment in the conveyance direction as it is necessary to process efficiently a lot of mandarin oranges M of many numbers of consignment and they were mentioned above, when the mandarin orange M of many numbers of consignment is carried in between short time, it will stand by using the standby location T. In the part where Container C is conveyed from the standby location T On the installation conveyance side of double-width transport-device 7a prepared along the conveyance direction of Container C, and the crossing direction The damper gear 4 to which

the mandarin orange M contained by Container C is made to emit is formed, and after being emitted in the condition that the mandarin orange M in Container C stacks with this damper gear 4, and there is no lap, installation conveyance of the mandarin orange M is carried out in double-width transport-device 7a. At this time, the empty containers C are collected separately.

[0016] As shown in drawing 2, the mandarin orange M by which installation conveyance is carried out in transport-device 7a After passing the washing processing section 8 which performs washing processing, wax treating, the desiccation processing accompanying it, etc., It switches to the condition that installation conveyance is carried out in the condition of being in the condition that the mandarin orange M by which installation conveyance was carried out in the scattering condition is located [ till then ] in a line in the shape of a column along the conveyance direction at a single tier with the CHANE riser 9 in a double-width conveyance path, and having branched to conveyance conveyor 7b of two or more trains (six trains). And the mandarin orange M conveyed in the state of a column in conveyance Rhine of such six trains, respectively the image measurement section 10 which picturizes at a time with one image pick-up means, such as a CCD camera, and distinguishes appearance information, such as a blemish, from the magnitude, information on a color, etc. by the image processing -- so that it may mention later Based on the internal quality measurement sections 11 which measure one internal quality, such as a sugar content of a mandarin orange M, and acidity, at a time by spectral analysis, and those measurement results, it judges to any of the classes, such as plurality, each mandarin orange M is corresponded. The classification processing section 13 grade equipped with the distribution equipment 12 grade distributed and supplied to conveyance Rhine separately prepared for every class, such as corresponding, is prepared. moreover -- such -- etc. -- the automatic packing section 14 which carries out setting weight [ every ] automatic packing of the classification \*\*\*\*\* mandarin orange M according to each \*\*\*\*\* based on the result of a class judging is formed. In addition, actuation of each part has composition controlled by the management equipment H which generalizes and manages the whole system.

[0017] Next, the configuration of the internal quality measurement section 11 is explained. In each of conveyance Rhine of six trains, this internal quality measurement section 11 is conveyed by each conveyance conveyor 7b in the state of a column, and it is constituted so that that internal quality may be measured one by one by making applicable to measurement each mandarin orange M which passes through the part for measurement. And the floodlighting section 16 equipped with the light source 15 as a floodlighting means to project light on a measured object (mandarin orange M) as shown in drawing 3 and drawing 4, the spectrum which receives and carries out the spectrum of the light which penetrated the measured object -- the concave grating 17 as a means, and the spectrum which measures the light which carried out the spectrum -- with the light sensing portion 19 equipped with the array mold photo detector 18 grade as a measurement means As opposed to the measured object which is equipped with the data-processing section 20 grade which asks for the internal quality information of a measured object, is constituted based on the measurement result of the array mold photo detector 18, and is further located in the part for measurement After the light projected from the floodlighting section 16 penetrates a measured object, it is constituted so that the floodlighting section 16 and a light sensing portion 19 may distribute to the right-and-left both-sides part of a measured object and may be arranged in the condition that light is received by the light sensing portion 19. In addition, said light source 15 consists of tungsten halogen lamps.

[0018] Said light sensing portion 19 a concave grating 17 and the array mold photo detector 18 It has composition arranged in the black box 21 which consists of a protection-from-light nature ingredient which shades the light from the outside. After the transmitted light which carried out incidence from ON \*\*\*\* 22 after the light projected from the floodlighting section 16 penetrated the measured object is reflected with a reflecting mirror 23, the optical reinforcement for every wavelength in which the part light reflex was carried out by the concave grating 17 and by which the light reflex was carried out at this rate has composition measured by the array mold photo detector 18. Said array mold photo detector 18 changes and outputs the transmitted light by which the part light reflex was carried out by the concave grating 17 to the signal for every wavelength while receiving light for every wavelength to



coincidence. Moreover, the array mold photo detector 18 consists of 1024-bit single dimension CCD line sensors, and can detect now the light of the wavelength of the range whose wavelength is 700nm - 1000nm.

[0019] Said data-processing section 20 is constituted using the microcomputer, and it is constituted so that the amount of components corresponding to the sugar content contained in a measured object by the quadratic differential value and the amount of components corresponding to acidity may be computed, while processing the output signal from the array mold photo detector 18 and acquiring the quadratic differential value in the wavelength field of an absorbance spectrum and an absorbance spectrum. An absorbance is  $\text{Log}(I/T)$  when the quantity of light of  $I$  and the transmitted light is set to  $T$  for the exposure quantity of light (criteria quantity of light) of the light source 15.

Coming out and defining, the data-processing section 20 computes the amount of components contained in a measured object based on the multiple regression analysis by the following formula 1.

[0020]

[Equation 1]

$Y = K0 + K1 \cdot A(\lambda 1) + K2 \cdot A(\lambda 2)$

[0021] However,  $Y$ ; The amounts  $K0$ ,  $K1$ , and  $K2$  of components; A coefficient  $A(\lambda 1)$ ,  $A(\lambda 2)$ ; quadratic differential value of the absorbance spectrum in the specific wavelength  $\lambda 1$ , and

[0022] In addition, for every component which computes the amount of components, the specific amount formula of components, the specific multipliers  $K0$ ,  $K1$ , and  $K2$  and wavelength  $\lambda 1$ , and  $\lambda 2$  grade are beforehand set up by the data-processing section 20, are memorized, and have at it composition which computes the amount of components of each component using the specific amount formula of components for every component of this.

[0023] And it is constituted as an optical unit  $U$  to which unitization of the floodlighting section 16 and the light sensing portion 19 was carried out in one. this optical unit  $U$  prepares removable in the condition freely separable from the data-processing section 20 -- having -- \*\*\*\* -- moreover -- the optical unit  $U$  -- respectively -- each \*\* -- a spectrum -- in the measurable condition It has two or more sets, and the measurement result of the optical unit  $U$  of these two or more groups is inputted, respectively, and the data-processing section 20 is constituted so that it may ask for the internal quality information of two or more measured objects measured in each optical unit  $U$ , respectively. As shown in drawing 3, that is, the optical unit  $U$  It is prepared in the condition of being contained in the casing 24 for optics in which the floodlighting section 16 and a light sensing portion 19 were formed in one. This casing 24 for optics In the body casing 25 by which the data-processing section 20 is contained, it consists of another objects, and the signal line 26 for signal transduction is also constituted by the connection list free [ separation ] through the connector 27, and the optical unit  $U$  is formed removable in the condition freely separable from the data-processing section 20. Said body casing 25 is equipped with the power unit 28 which supplies the power source over the data-processing section 20, and the cooling-fan 29 grade cooled so that the interior of casing may not become an elevated temperature, since there is a possibility that operation precision may fall if a temperature change is large.

[0024] And as shown in drawing 2, in each of conveyance Rhine of six trains, it has one piece at a time, said data-processing section 20 has composition prepared two sets, and said optical unit  $U$  has the composition that each signal from two or more three optical units  $U$  of every is processed in the one data-processing section 20. Namely, while the signal output timing in three optical units  $U$  shifts timing with time-division system Although it has the composition of being inputted into the data-processing section 20, respectively and a detailed explanation is not carried out, in the data-processing section 20 The internal quality (a sugar content, acidity, etc.) of the measured section measured in each optical unit  $U$  is searched for by carrying out data processing of the timing based on the measurement information from each optical unit  $U$  shifted and inputted, where time sharing is carried out. And the measurement result will be sent to management equipment  $H$ , and will be used as information for classification.

[0025] Thus, when change has arisen in the property by the case so that the light source 15 may be exchanged to a new thing by being constituted, or long-term use, it sets. When the wavelength-calibration processing which decides what the wavelength of the light which carries out ON light has

become is needed for each component of the array mold photo detector 18, tuning can be performed in somewhere else which separates and removes the optical unit U and is different from the installation part of equipment. In addition, when removing one of things among six optical units U, in other conveyance Rhine, measurement processing can be continued by stopping conveyance of the mandarin orange M in conveyance Rhine which corresponds with said CHANE riser 9.

[0026] If explanation is added about the above-mentioned wavelength-calibration processing, as shown in drawing 5, the light guide section material 30 which leads the light for measurement projected from the light source 15 where an external light is covered to ON \*\*\*\* 22 of a light sensing portion 19 will be prepared separately. The section is equipped with the filter 31 for proofreading which is made to penetrate the light for measurement and is made into the light for proofreading in the middle of this light guide section material 30. The light for proofreading after passing this filter 31 for proofreading As shown in drawing 6, it is the bundle of rays which equipped specific fixed wavelength ( $\lambda S1$ ,  $\lambda S2$ ) with the peak. From the physical relationship of the photo detector of the pair of the array mold photo detector 18 which will receive the peak wavelength and such peak wavelength of the pair specified beforehand, correspondence can be taken between each component which constitutes the array mold photo detector 18, and the wavelength of the light which each component receives.

[0027] By the way, when correspondence relation which was described above must always be adjusted to an initialization condition and the same condition, for example, the light source 15 is exchanged, after that new light source 15 is attached, this correspondence relation must be adjusted. That is, as shown in drawing 5, the optical unit U is equipped with said light guide section material 30. Signal processing is carried out with the signal processor 32 of the dedication which carried out the spectrum of the light for proofreading after passing the filter 31 for proofreading, and measured by the array mold photo detector 18, and prepared the measurement result separately. The sense of a concave grating 17 will be tuned finely, or the location of the array mold photo detector 18 will be finely tuned so that it may double with the thing which is having the photo detector corresponding to specific wavelength ( $\lambda S1$ ,  $\lambda S2$ ) initialized based on the processing result. In addition, it may be made to perform measurement processing of the dark current measured where the exposure quantity of light (criteria quantity of light) and incident light of the light source 15 which were described above are intercepted suitably. Although it is hard to perform such a maintenance in the installation part of equipment, it can carry out easily by separating the optical unit U and carrying out in another part.

[0028] [Another operation gestalt] Another operation gestalt is listed hereafter.

[0029] (1) Although the casing 24 for optics by which the optical unit U is constituted from an above-mentioned operation gestalt, and the body casing 25 by which the data-processing section 20 is contained illustrated that to which it consists of another objects and they are connected only with a signal line, it is good also as a configuration which can connect for example, not only a configuration such but casing for optics, and body casing in one in the disengageable condition.

[0030] (2) Although what consists of above-mentioned operation gestalten so that it may ask for the internal quality information of two or more measured objects which the measurement result of every 3 sets of optical units U is inputted into said data-processing section 20, respectively, and are measured in each optical unit U, respectively was illustrated It may be good also as a configuration which prepares 2 sets or forms for example, not only a configuration such but 4 or more sets of optical units U to the one data-processing section 20, or the configuration of forming one optical unit U to the one data-processing section 20 may be used.

[0031] (3) Although said measured object was conveyed in the state of the column by conveyance conveyor and what is constituted so that it may pass through said part for measurement one by one was illustrated with the above-mentioned operation gestalt, it is good also as a configuration which supplies every one-piece measured object to the part for measurement for example, such by not only configuration but by the handling robot, or supplies a measured object to the part for measurement by handicraft.

[0032] (4) although what measures a mandarin orange M as said measured object was illustrated with the above-mentioned operation gestalt -- not only the mandarin orange M but an apple -- making -- etc. -

- other fruit is sufficient and vegetables, such as not only fruit but an eggplant and a tomato, etc. are sufficient.

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[Translation done.]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The whole fruit-sorting facility outline block diagram

[Drawing 2] A fruit-sorting facility is a block diagram a part.

[Drawing 3] The perspective view of an internal quality metering device

[Drawing 4] The sectional view showing the configuration of an optical unit

[Drawing 5] The explanatory view showing an adjustment working state

[Drawing 6] The spectral characteristic Fig. of the filter for proofreading

[Drawing 7] Drawing showing the conventional internal quality metering device

[Description of Notations]

7b Conveyance conveyor

15 Floodlighting Means

16 Floodlighting Section

17 Spectrum -- Means

18 Spectrum -- Measurement Means

19 Light Sensing Portion

20 Data-Processing Section

U Optical unit

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[Translation done.]

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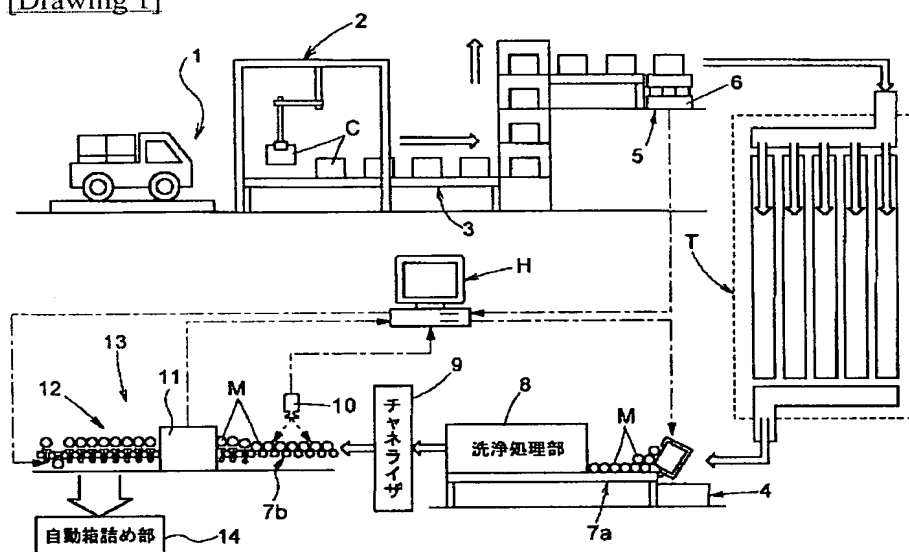
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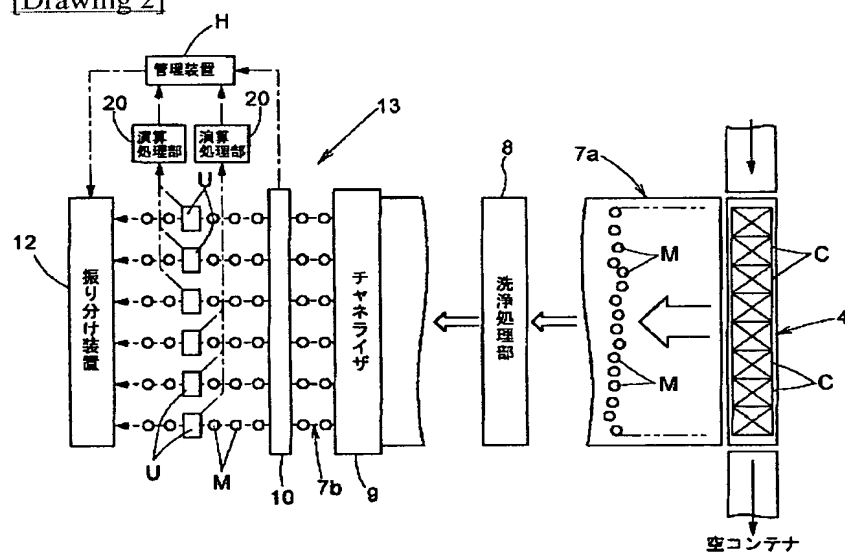
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## DRAWINGS

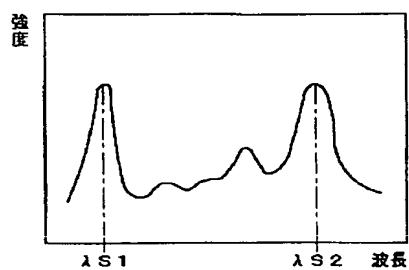
[Drawing 1]



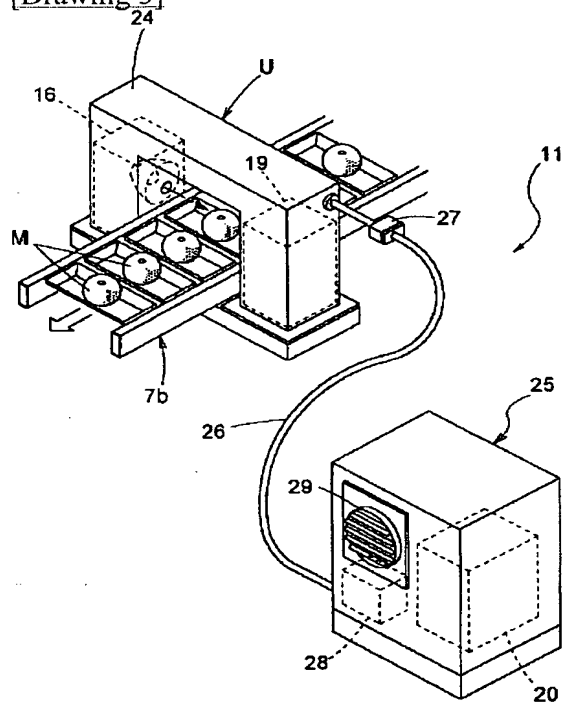
[Drawing 2]



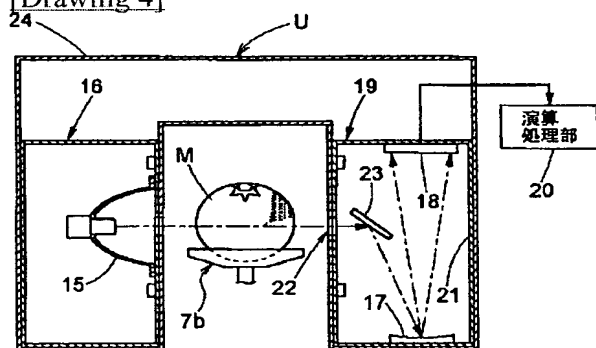
[Drawing 6]



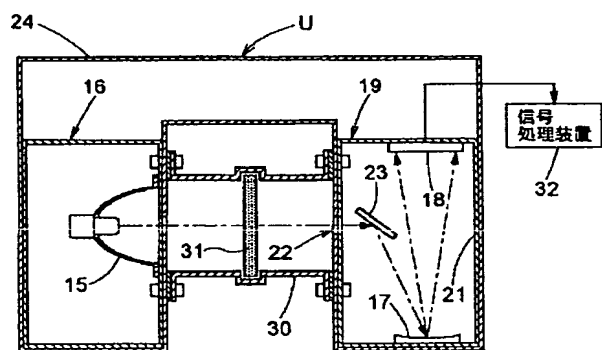
[Drawing 3]



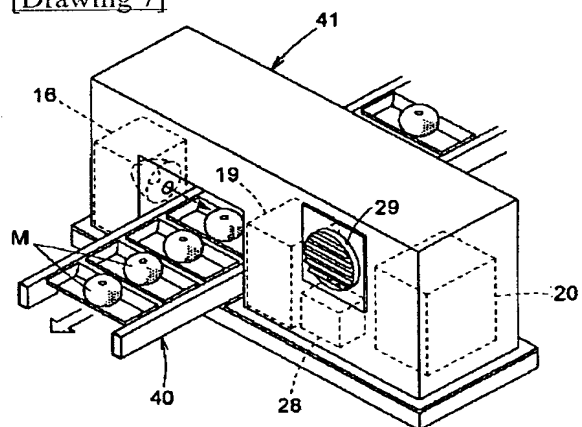
[Drawing 4]



[Drawing 5]



[Drawing 7]



[Translation done.]